

Remarks

Claims 24 - 46 are pending. Favorable reconsideration is respectfully requested.

Claims 24 and 35 have been objected to for use of the numerology $20 \cdot 10^{-4}$. This has been replaced by 20×10^{-4} as suggested by the Examiner. Withdrawal of the objection to these claims is solicited.

Claims 24 and 35 have also been amended to ensure that the claim language is clear. In particular, the paragraph beginning with "from 85 % to 100 %" has been merged with the preceding paragraph, since it is that paragraph which the merged paragraph modified; component c) has been amended to recite that the monomers c) are different from the monomers b); and the paragraph which defines the solvent has been amended to describe it as a solvent mixture. Claim 24 has been amended to recite that the copolymer product or its hydrolysate is solid and transparent, support for which may be found in numerous portions of the specification, particularly page 3, lines 37 - 38. New claim 47 has been added to claim a preferred range of silicone content, support for which may be found on page 6, line 27. None of the amendments raise any issue of new matter.

The subject invention is directed to a unique polymerization process whereby a vinyl ester monomer and a copolymerizable organopolysiloxane are solution copolymerized in a mixture of non-aqueous solvents, at least one solvent having a transfer constant C_s to vinyl acetate of $> 20 \times 10^{-4}$ at 70°C , and to the novel polymers produced by this process.

In the past, attempts to copolymerize conventional unsaturated monomers such as vinyl acetate with copolymerizable silicone compounds has led to poor incorporation of the silicone into the polymer, both in terms of amount incorporated as well as its non-uniform distribution. This non-uniform distribution produces silicone-rich domains which are incompatible with the remainder of the polymer, and which therefore destroy the transparency of the product. Only white or at best cloudy polymers could be obtained. These silicone rich

domains also attract unpolymerized silicone monomers, the result of which is continued migration of unreacted silicone from the solid polymer. Both the opaque nature of the polymer as well as the tendency for migration of silicone from the polymer is generally undesirable.

As indicated in the present specification, among the objects of the invention were providing vinyl ester polymers with appreciable silicone content, yet which are transparent. Moreover, this silicone content should be permanent, i.e. migration should be very minimal, with preferably no migration at all. These objects were surprisingly and unexpectedly achieved by Applicants' non-aqueous (solution) polymerization process employing at least two solvents, at least one with a transfer constant $> 20 \times 10^{-4}$. the polymerization proceeds totally in solution, providing a single phase polymerization mass. Isolation of the polymer from this polymerization mass surprisingly results in transparent and not opaque or translucent polymers. Moreover, event though very large amounts of silicone are incorporated, there is little or no silicone migration from the polymer.

By contrast, when a single solvent is employed, even one meeting the transfer constant limitation, transparent polymers cannot be prepared, as shown by Examples 1 (Comparative) and 2. The only difference between these two examples was the solvent employed. Example 1 (Comparative) employed a single solvent, while Example 2 employed the same solvent plus a second solvent, i.e. a solvent mixture. The reaction mass of Example 1 was two phase, and the polymer was cloudy/white. The reaction mass of Example 2 was a single phase, and the polymer was transparent. Repetitions of Example 1 (Comparative) with differing monomer contents and addition rates (Examples 3, 4 (Comparative)) all produced white and not transparent products.

Claims 24 to 34 and 38 to 46 have been rejected under 35 U.S.C. § 103(a) over DeSimone et al. U.S. Patent 5,780,553 ("*DeSimone*") or Getson U.S. Patent 4,172,101 ("*Getson*"). Applicants respectfully traverse this rejection. The Examiner is indeed correct that product by process claims are examined based on what the product is and not how it is made, an interesting but correct dichotomy in U.S. Patent law, since process steps are

limitations in litigation of product-by-process claims. However, the products in this case are clearly different and non-obvious over the prior art products.

DeSimone teaches the preparation of addition polymers by heterogenous polymerization in liquid or supercritical carbon dioxide. As indicated by *DeSimone* in columns 1 and 2, polymerization in CO₂, while environmentally friendly, is not effective in producing polymers without the aid of surfactants which keep the insoluble polymer particles dispersed so that they may continue to grow in size and molecular weight. *DeSimone's* earlier patents, 5,312,882 and 5,382,623 (to which the present *DeSimone* patent claims priority through an extensive chain of applications) disclose specific amphiphilic surfactants. However, *DeSimone* notes (Column 2, lines 1 - 8) that a different "finely tuned" surfactant is necessary for each different monomer. The *DeSimone* '553 patent discloses the use of steric stabilizers to keep the growing articles in dispersion. These steric stabilizers are macromonomers which are themselves amphiphilic, having one portion which is attracted to (or even bonded to) the polymer particles, and one portion which is soluble in CO₂. Examples of "soluble" portions are organopolysiloxane ("silicone") moieties and fluorinated hydrocarbon moieties. *DeSimone* prepares these amphiphilic stabilizers *in situ* from a stabilizer precursor. Since they are prepared at the same time as the polymer, the polymer soluble portion of the amphiphilic dispersant is automatically the same as the polymer itself.

Thus, *DeSimone* has no intention to provide addition copolymers containing polymerized silicone moieties. He merely polymerizes the addition-polymerizable monomer (i.e. methylmethacrylate, vinyl chloride, vinyl acetate) in the presence of an addition-polymerizable silicone macromer precursor. During polymerization, two polymerizations take place, one involving the conventional monomers only and one involving the macromer precursor. For example, when polymerizing methyl methacrylate and vinyl-functional PDMS, the major product is polymethylmethacrylate, with a minor portion of a silicone/methylmethacrylate oligomer (macromer) which serves as an amphiphilic dispersant. Any silicone actually incorporated into the polymer product is purely accidental.

For example, *DeSimone's* Example 1 products a polymethylmethacrylate polymer containing 7.3% by weight PDMS. However, this PDMS is migratory, not bound to the polymer, as shown by Examples 2 and 3 where following washing by hexane (Example 2) or extracting with CO₂ (Example 3), the amount of silicone remaining was only 0.24 and 0.26% by weight respectively.

Observe also, the only (?) vinyl ester example (Example 13), where vinyl acetate was copolymerized with ethylene in the presence of PDMS macromonomer. Note that no PDMS was incorporated at all: the polymer consists solely of repeating moieties derived from vinyl acetate and ethylene. Note also that all the products disclosed are white, not transparent.

DeSimone employs only a single solvent (CO₂) whose transfer constant is unknown. The characteristics of CO₂ are so completely different from Applicants' non-aqueous solvents that one skilled in the art would not expect the products to be the same. Moreover, while Applicants' polymerization is a one-phase (solution) polymerization, *DeSimone* intentionally requires a heterogenous polymerization. One skilled in the art would also not expect polymers prepared in solution to be the same as those prepared in emulsion, suspension, or dispersion.

The polymers of Applicants are transparent, and also exhibit little or no migration of silicone, despite containing silicone in high amounts. Note, for example, that the silicone content in Applicants' Examples ranges from 10.75 wt. % (Example 5) to 35.9 weight percent (Example 9). These amounts are "polymerized-in" silicone, not silicone simply adsorbed or dissolved in the polymer. Despite the large amount of silicone, the polymers are still transparent, and show little or no silicone migration. The polymers of *DeSimone*, on the other hand, contain very little bound silicone (e.g. 0.24, 0.26 wt.%, if that (more extraction/washing might remove the remainder)), and the polymers are white, not transparent. *DeSimone* does not even mention the problems solved by Applicants: transparent, migration-free polymers, and does not teach or suggest how such polymers might be obtained.

Applicants submit that their claimed, transparent polymers are non-obvious over *DeSimone*, and respectfully request withdrawal of the rejection over *DeSimone*.

The claims have also been rejected over Getson U.S. Patent 4,172,101 ("*Getson*"). *Getson* discloses addition-polymer-modified organopolysiloxanes containing particulate matter, prepared by copolymerizing a vinyl-functional silicone with one or more conventional monomers, i.e. alkenes, acrylate esters, styrene, vinyl chloride, and vinyl esters. The polymerization takes place in a liquid medium which is a non-solvent for the polymer (column 5, lines 41 - 42). Water is preferred. The polymerization is a typical free radical-induced emulsion polymerization, but the polymer particles produced contain *in situ*-generated particulate matter. See, e.g. the Abstract, column 2, lines 4 - 19; column 9, lines 39 - 45. The *in situ* generated particles serve as reinforcing fillers in silicone elastomers later prepared from these polymers by hydrosilylation with Si-H functional silicones. Because of the particulate matter contained in the polymers, they cannot be transparent, and in fact the polymers produced in the examples are described as being white and opaque.

The polymerization of *Getson*, like that of *DeSimone*, is a heterogenous polymerization. Also like *DeSimone*, *Getson* does not disclose the use of two different solvents, one of which has a transfer constant $> 20 \times 10^{-4}$. Thus, in addition to *Getson's* teaching that his polymer contains particulate matter and thus cannot be transparent, the very different nature of his polymerization process would generate the conclusion that his polymers are very different than those of Applicants.¹ It is noted that *Getson* also, like *DeSimone*, does not even mention either of the problems addressed by applicants: transparency and freedom from silicone migration. Withdrawal of the rejection of the claims over *Getson* is respectfully solicited.

¹ Note that many if not most of *Getson's* polymers are liquids.

Applicants submit that the claims are now in condition for Allowance, and respectfully request a Notice to that effect. If the Examiner believes that further discussion will advance the prosecution of the Application, the Examiner is highly encouraged to telephone Applicants' attorney at the number given below.

Respectfully submitted,

Kurt Stark et al.

By 

William G. Conger

Reg. No. 31,209

Attorney/Agent for Applicant

Date: December 15, 2006

BROOKS KUSHMAN P.C.
1000 Town Center, 22nd Floor
Southfield, MI 48075-1238
Phone: 248-358-4400
Fax: 248-358-3351